Barium Reduction of Intussusception in Infancy

EDWARD J. DENENHOLZ, M.D., and GEORGE. S. FEHER, M.D., Modesto

• *Barium enema reduction was used as the initial routine treatment in 29 infants with intussusception. In 22 of them the intussusception was reduced by this means. In three of eight patients operated upon the intussusception was found to be reduced. Four of the remaining five patients had clinical or x-ray evidence of complications before reduction by barium enema was attempted.*

Twenty-one of the patients, all of whom were observed in private practice, were treated without admission to the hospital. After reduction, these patients were observed closely by the clinician. None of these patients showed clinical or x-ray signs of complications before reduction.

Certain clinical and roentgen criteria must be satisfied before it can be concluded that reduction by barium enema is complete.

If there are clinical signs of complications with x-ray evidence of small bowel obstruction, only a very cautious attempt at hydrostatic reduction should be made. As the time factor is generally a reliable clinical guide to reducibility, the late cases should be viewed with greater caution. Long duration of symptoms, however, is not per se a contraindication to an attempt at hydrostatic reduction.

OPINION AS TO the relative merits of the operative and nonoperative treatment of intussusception in infancy varies widely. One view, probably that of a majority of surgeons and pediatricians, is that this condition demands prompt surgical intervention and that barium enema has no real place in the therapeutic regimen. Ravitch[16] and others,[4] however, believe that treatment of an infant with intussusception should be begun with an attempt at hydrostatic reduction, and that the majority of patients with intussusception in infancy can be successfully treated by this means. Although this nonoperative treatment has long been the method of choice in the Scandinavian countries,[11, 12] and in Australia,[6, 10] it has been looked upon with some distrust in this country. Renewed interest in the nonsurgical method was stimulated, however, by the observations of Ravitch and co-workers.[14, 15, 16] After extensive clinical and experimental observation, these investigators concluded that mortality, morbidity, and length of hospital stay are all lessened by the hydrostatic as compared with the surgical method. Ranging between these two opposing beliefs are numerous gradations of opinion, including the proposal that barium reduction may be employed, but that it should be followed in each instance by laparotomy to verify reduction.

PRESENT STUDY

The present report is based on observation of 29 consecutive infants with intussusception who were treated in private practice in a four-year period ended in April 1954. The infants in this study ranged in age from 5 months to 32 months. Fifteen were under one year of age, 10 between one and two years, and four over two years of age. The duration of symptoms at the time the patient was first observed varied from one hour to five days. In eight cases symptoms were present for less than 12 hours, in ten from 12 to 24 hours, in three from 24 to 48 hours, in three from 48 to 72 hours, and in five over 72 hours.

All infants suspected of intussusception were given a barium enema examination to confirm the diagnosis; and, if intussusception was observed, hydrostatic reduction with barium was used as the initial treatment. All the barium reduction procedures were performed by one of the authors (G.S.F.) or by his associate. The clinical examinations were made either primarily, or in consultation, by one of the authors (E.J.D.) or his associates, in all but five patients. These five patients were referred directly for roentgen study by the family physician. With the exception of one patient in whom the examination was made in the hospital, all x-ray procedures were carried out in the office of the radiologist. This was originally done because of the superior facilities in the office as compared with the hospital, but was continued because of the gratifying results. Early in the study, a surgeon was notified routinely that barium reduction was being attempted, so that the operating room could be alerted. As the study progressed, this procedure was followed only in complicated cases in which it was suspected barium reduction might not be effective or feasible.

Presented before the Section on Radiology at the 83rd Annual Session of the California Medical Association, Los Angeles, May 9-13, 1954.

Patients in whom barium reduction was successful were not admitted to the hospital. Instead, they were observed in the radiologist's office for 30 minutes to one hour, and if no evidence of recurrence of symptoms developed, the patient was permitted to return home. In the majority of cases, the pediatrician was present for all or part of the procedure and instructions to parents as to care of the patient at home were given by him. Fluids were given by mouth as soon as the infant appeared to want them after reduction. Antibiotics were administered to some of the infants in whom the intussusception had been present for over 24 hours as a prophylaxis against specific diarrhea, and antibiotic therapy was also continued in cases in which they were already being administered for antecedent illness. The parents were asked to report immediately any recurrence of symptoms and to make a progress report by phone in two to eight hours, the time of report depending on the time of day or night and upon the nature of the case. They were informed of the probable development of loose stools for a day or two and of the possible presence of blood and mucus in the first stools following reduction. In all cases it was asked that the patient be returned to the pediatrician the following morning for examination even in the absence of symptoms. The one patient in whom the intussusception was reduced in the hospital (at 2 a.m.) was discharged eight hours following the reduction. The patients in whom reduction was considered not to have been effected were immediately referred to the hospital. In all but two of these patients the condition was recognized as late or complicated, and the probability of the need for operation had already been discussed with the referring family physician or with the surgeon when the nature of the case was revealed to the pediatrician or the radiologist.

TECHNIQUE OF BARIUM REDUCTION

The technique of hydrostatic reduction has been described in detail by Ravitch and McCune,[16] and by Girdany, Bass and Grier.[4] Since the authors have employed some modifications, however, a brief outline may be worth while.

The examination begins with a plain film of the abdomen. If this shows evidence of small bowel obstruction and/or peritonitis, barium enema is performed with great caution.[7] (This policy was adopted because in earlier studies it was observed that in cases in which there was clinical evidence of complications, such as peritonitis, intestinal obstruction, toxemia and prostration, and x-ray evidence of small bowel obstruction, hydrostatic reduction was not successful.) Before the x-ray studies are started, the parents of the infant are instructed in immobilizing the infant, and particularly in the manner of compressing the baby's buttocks to prevent expulsion of the tube. Enlisting the aid of the parents serves two purposes: (1) it is psychologically sound, since the parents feel that they are actively aiding in the treatment of their child, and it avoids anxieties that may result when they are not permitted in the examining room or when they view formidable restraints. (2) It prevents undue exposure of the x-ray personnel. No mechanical restraints or sedation were employed.

A child's-sized, ungreased Bardex catheter is inserted into the rectum and inflated. The barium is permitted to enter the rectum and distal colon. After the intussusception has been recognized fluoroscopically, spot films are made. Reduction is then begun by slowly elevating the enema container from a position slightly above table level to that needed to overcome the resistance of the intussuscepted area. In the majority of cases this is three to three and a half feet above the level of the table. In no case is the container raised more than four feet above the top of the table. During the reduction, spot films of the advancing barium column are made. In cases in which there are no complications, if the barium reaches an impasse and does not enter the terminal ileum within a few minutes, the patient is allowed to evacuate and the procedure is begun again. In some cases reflux into the ileum occurs during the evacuation, and the intussusception is found to be reduced. At times evacuation is accomplished accidentally and after the second filling the reduction is then completed with relative ease. No more than three fillings are used in any patient, and rarely is it necessary to use even three. At no time is manual palpation used. In the late or complicated cases, as evidenced by clinical and x-ray findings, only one cautious attempt at barium reduction is made. If this is unsuccessful, the patient is promptly referred for operation.

CRITERIA FOR REDUCTION

In the present series certain clinical and radiologic criteria had to be satisfied before reduction was considered complete. Clinically, a dramatic and striking change in the patient is evident when reduction has been effected. An infant who previously has been screaming in intense agony, or who has been extremely apathetic and listless between episodes of abdominal pain, will abruptly fall into a deep sleep on the examining table, or will begin to smile or become active or engage in play. If an abdominal mass was previously noted, it will have disappeared.

Many patients, especially if treated early, will show no particular symptoms during the 24 hours following reduction. It should be recognized that some patients will have loose stools (postreduction diarrhea) for one to two days following reduction. Blood in the stools with mucus is also often present

the day following reduction. Occasional abdominal pain or cramp, usually not severe, may less frequently occur. These symptoms are similar to those that are seen after surgical reduction, but are generally much less severe. Observation of the patient soon reveals that reduction has been complete, since the pain is only fleeting, the infant is active, stools without blood are passed, and vomiting, distention, shock, and abnormal abdominal findings are not present. It is of utmost importance to recognize the postreduction symptoms for what they are, for if misunderstood they may lead to considerable anxiety and even unnecessary operation. Fever, except of slight degree, is not usually present after barium reduction, as it is after operative treatment.

Radiologically, reduction is diagnosed when the cecum is filled and there is a free flow of barium into the terminal ileum. It is important to recognize that a filling defect at the ileocecal valve, after the terminal ileum has been filled, is often due to edema of the mucosa, rather than to incomplete reduction.

RESULTS

In 22 of the 29 patients reduction was successfully accomplished by means of barium enema as described.* In all patients in whom intussusception was present for 48 hours or less, barium reduction was successful. One of these patients was operated upon, however, because of the family physician's insistence, and at operation the intussusception was observed to be reduced. In two additional patients early in the series the radiologist was not certain that complete reduction had occurred and operation was carried out. In both instances, the intussusception was found to be reduced. It is recognized that anesthesia may have brought about the reduction in these patients, and they are not considered as having had reduction by hydrostatic means. In the remaining five patients, barium reduction was unsuccessful and operation was performed. These patients first came under observation late and the duration of symptoms before barium reduction was attempted was 50, 74, 88, 96 and 120 hours. In one of these patients the intussusception was found to be partially reduced immediately distal to the cecum and was easily reduced at operation. In four patients clinical evidence of complications, such as toxemia, prostration, fever (102° to 104° F.) and a variable degree of distention, was present. In three of these patients there was evidence of small bowel obstruction on a plain film of the abdomen. In all five patients intussusception of considerable magnitude was observed at operation. The intussusception was reducible at operation in three patients and in the other two it was considered nonviable and irreducible. In one of these a primary resection was done, with recovery. Two patients died. One of them (who had had symptoms for 96 hours before operation) died of toxemia about 40 hours after operation. The other (in whom symptoms had been present for five days) died 12 hours postoperatively of peritonitis and toxemia.

*Since this report was written, intussusception was reduced by barium enema in three additional early cases.

DISCUSSION

The obvious advantage of barium reduction is that in many instances the infant is spared anesthesia and an abdominal operation, although the advocates of operative treatment point out that the surgical mortality is low. A comparison of mortality rates by the two methods of treatment has been cited by others. Our small series does not lend itself to such a comparison. Another advantage is the lessening of morbidity. The studies of Ravitch,[15, 16] and of Bass and Girdany,[1] indicated a considerable shortening of the hospital stay as well as a decreased incidence of fever, diarrhea and vomiting in the nonoperative patients as compared with the operative.[1] As far as is known, the present study is the only one in which the majority of the patients were treated on an outpatient basis. Of 28 patients reported by Bass and Girdany,[1] four were returned home immediately after operation. Twenty-one of the patients in the present series were not admitted to the hospital at any time. It should be pointed out, however, that all these patients were observed in private practice, that they could be followed closely, and that parental cooperation could be expected. It should be emphasized that this procedure would not be applicable, except in selected instances, in clinic practice.

As was stated previously, the major objections that have been raised to reduction of intussusception by this method are that: (a) gangrenous bowel may be reduced; (b) a rupture of the bowel may be brought on by the barium enema; (c) a specific etiologic factor for the intussusception, such as a Meckel's diverticulum or polyp, may be overlooked; (d) ileoileal intussusceptions cannot be diagnosed by this method; (e) it is difficult to be certain by x-ray that reduction has occurred; and (f) the procedure is tedious and may thus cause serious delay in the patient's treatment. Experimental studies have shown that gangrenous bowel cannot be reduced by this method, and that much greater pressures than those used for reduction are required to produce intestinal rupture.[11, 15] The burden of the pressure in the hydrostatic method is borne by healthy bowel and is diffusely distributed. Actually, the method is quite similar to that employed for reduction at operation. Essentially, the surgeon by squeezing the bowel distal to the intussusception increases the intraluminal pressure and forces the intussusception back. This is precisely what the barium

does in the hydrostatic pressure method, except that the enema does not contuse the bowel wall or abrade the serosa.

In the majority of instances of intussusception in infancy no specific etiologic factor is found at operation. Lesions such as Meckel's diverticulum or polyps are more likely to be encountered in older children. In no instance in this series did a patient return because of symptoms that could be attributed to a causative lesion that was missed at operation. There were no recurrences in patients in the present series. The authors agree with Ravitch and Morgan[16] that, should recurrence develop, barium reduction should be done and the abdomen then explored for the presence of a possible causative lesion.

In the great majority of cases, intussusception is ileocecal or ileocolic. There were no cases of ileoileal intussusception in the present series. This condition cannot be diagnosed with certainty by the method described herein, but in the event of failure to find barium enema evidence of ileocolic intussusception, in the face of a suggestive clinical picture, together with x-ray evidence of small bowel obstruction, the authors would promptly advise surgical intervention.

The diagnosis of adequate reduction can usually be readily made by means of the barium enema. One of the troublesome features is the presence of a filling defect at the ileocecal valve following attempt at reduction. In the authors' experience, if the barium flows freely into the terminal ileum and if the patient shows obvious improvement as previously noted, the defect is due to edema and does not indicate incomplete reduction. The identical defect has been observed in patients who were given barium orally after successful surgical reduction.[4] If the criteria previously cited are not present, the patient should be promptly subjected to operation.

Ileocecal or ileocolic intussusception can readily be diagnosed, even before clinical symptoms are acute, by means of barium enema. Although many observers[2, 5, 13] feel that barium enema is rarely needed to confirm the diagnosis, the authors have found it a very helpful clinical tool. Since the patients in the present series were observed in private practice, they were, as a group, brought to us for examination earlier than would patients in a clinic series. Five of the patients were seen between one and four hours after the onset of symptoms. It is in early cases that the barium enema is of most value. Perhaps the infant's color is good and he plays between attacks. There may be no shock, no bloody stools or bloody mucus on the examiner's fingers and no abdominal mass present. A plain film of the abdomen may show no abnormality. Oftentimes the infants have either mild enteritis or upper respiratory tract infection preceding the attack, and these conditions may cause deceptive variations in the clinical picture. It is in such circumstances that barium enema may be most helpful either in confirming the diagnosis or in showing a free flow of barium into the ileum. And in either event it is probable that the patient can be spared operation. If intussusception is present, an attempt at barium reduction may be made readily. It is possible that the feeling which appears to exist among some surgeons that intussusception is easy to diagnose, may well have resulted from the fact that the patients they examine are often first screened by the pediatrician or family physician.

The procedure need not usually be tedious or time-consuming. It can be started much sooner than an operation and it takes about 20 to 30 minutes. If operation has to be done later, in some instances, the intussusception will have been partially reduced by the enema, thus facilitating the surgical procedure. Ravitch[16] advocated a simple McBurney incision in such instances.

The time factor is of great importance in the success of barium reduction. Generally speaking, the earlier the patient is treated, the more readily can barium enema reduction be effected. Irreducibility is determined by adhesions between the sheaths and by the degree of edema. Both factors increase with time. Duration of symptoms alone is not entirely reliable however; in a few late cases in the present series, reduction was relatively easy and in a few early cases it was more difficult. Although not observed by us it is conceivable that complications might be present in early cases. In cases in which there were complications, intestinal obstruction or peritonitis, reduction was not accomplished with barium enema; but in those cases it was done only with difficulty at operation, if it could be done at all.

In the present series an attempt was made to obtain close cooperation between the pediatrician and radiologist. The responsibility for prompt referral of the patient to the radiologist for an attempt at reduction and the close observation and contact with the patient following reduction rested primarily with the clinician. The radiologist's responsibility lay in adequately carrying out the attempt at reduction and in the x-ray recognition of a successful reduction or of failure. The decision to desist or persist in efforts at reduction was a joint one, arrived at in each case by an appraisal of the entire clinical picture. The great majority of the reports in the literature concerning the treatment of intussusception and evaluating the various methods of treatment have been made by surgeons. Ravitch, a surgeon and proponent of barium reduction, emphasized strongly that barium reduction is a surgical procedure. The authors feel that it is primarily a roentgen technique to be pursued by radiologists in close cooperation with pediatricians, general physicians or surgeons, as the situation presents. It is of interest that of the

patients seen by the authors from the outset of symptoms, there was only one in the entire series subjected to operation. In that instance, early in the series, the clinician and the radiologist felt some doubt that successful reduction had occurred; but at operation complete reduction with viable bowel was observed.

We concur with Girdany, Bass, and Grier that the radiologist should become fully acquainted with the clinical aspects of intussusception and expert in the technique of hydrostatic reduction. Interest and willingness are most important; half-hearted, routinized attempts at reduction are usually doomed to failure.

1700 McHenry Village Way, Modesto.

REFERENCES

1. Bass, L. W., and Girdany, B. R.: Intussusception: a review of 172 cases with comparison of results of treatment by hydrostatic pressure and by surgery, Abs. Trans. Am. Ped. Soc. A.M.A. Amer. J. Dis. Child., 86:625, 1953.

2. Caffey, J.: Pediatric X-ray Diagnosis, Year Book Publishers, Chicago, 1950, p. 442.

3. Gellis, S. S.: Editorial comment, Year Book of Pediatrics, Year Book Publishers, Chicago, 1953-54, p. 207.

4. Girdany, B. R., Bass, L. W., and Grier, G. W.: Reduction of ileocecal intussusception by hydrostatic pressure, Radiology, 60:518, 1953.

5. Gross, R. E.: The Surgery of Infancy and Childhood, W. B. Saunders Co., Philadelphia, 20:287, 1953.

6. Hipsley, P. L.: Intussusception and its treatment by hydrostatic pressure based on analysis of 100 consecutive cases so treated, M. J. Australia, 2:201, 1926.

7. Ji-Toong, L.: Intussusception in infants and children, Radiology, 62:504, 1954.

8. Kahle, H. R., and Thompson, C. T.: Diagnostic and therapeutic considerations of intussusception, Surg. Gyn. and Ob., 97:693, 1953.

9. Moore, T. C.: Management of intussusception in infants and children, Ann. Surg., 135:184, 1952.

10. Nelson, T. Y.: The place of hydrostatic pressure in the treatment of intussusception, M. J. Australia, 1:825, 1949.

11. Nordentoft, J. M.: Conservative treatment with barium enema of intussusception in children, Acta Radiol., 20:128, 1939.

12. Nordentoft, J. M.: The value of barium enema in the diagnosis and treatment of intussusception in children. Illustrated by about 500 Danish cases, Acta Radiol. (Supp.), 51:5, 1943.

13. Potts, W. J.: Brennemann's Practice of Pediatrics, W. F. Prior Co., Hagerstown, Md., 3:64.

14. Ravitch, M. M., and McCune, R. M.: Intussusception in infants and children, J. Ped., 37:153, 1950.

15. Ravitch, M. M., and McCune, R. M.: Reduction of intussusception by barium enema: a clinical and experimental study, Ann. Surg., 128:904, 1948.

16. Ravitch, M. M., and Morgan, R. N.: Reduction of intussusception by barium enema, Ann. Surg., 135:596, 1952.